INFLUENCE OF SOME STIMULATORS ON THE GRAIN YIELD AND GRAIN QUALITY OF TWO DURUM WHEAT CULTIVARS

Grozi Delchev[1]

Abstract: The research was conducted during 2010 - 2012 on pellic vertisol soil type. Factor A – cultivars, include 2 Bulgarian durum wheat cultivars: Deyana and Zvezdica (*Triticum durum var. valenciae*). Factor B – stimulators, include 9 variants: untreated check and 5 growth stimulators – H-40 in doses of 300 and 500 ml ha^{-1}, XH-100 in doses of 1 and 1.2 l ha^{-1}, TH-140 in doses of 2.5 and 2.8 l ha^{-1}, X-80 in dose of 800 ml ha^{-1} and T – 100 in dose of 2.5 l ha^{-1}. All stimulators were treated during the tillering stage of durum wheat.

It was found that the highest grain yield at durum wheat cultivars Deyana and Zvezdica is obtained by influence of growth stimulators XH-100 and TH-140. Increase the dose of stimulator H-40 depresses durum wheat. The lowest yields are obtained by use of stimulators X-80 and T-100 at the both durum wheat cultivars. The grain yield increase by investigated stimulators is due to the increase in the grain number per spike and the grain weight spike in main tiller and second tiller. The 1000 grain weight, test weight, virteousness, protein quantity, wet and dry gluten quantities are increased by influence of the investigated growth regulators. Physical and biochemical properties oh the grain are the highest by treatment with stimulators XH-100 and TH-140. The use of these two plant growth regulators is suggested as an element of the technology for growing of durum wheat.

Key words: durum wheat, stimulators, grain yield, structural elements of the yield, grain quality

Introduction

The formation of grain yield of the durum wheat is ongoing throughout the growing season and depends from genetic potentialities of the cultivar, the technology of growing and the weather conditions (Radišič et al., 1997). Receiving of more grain with higher quality is the result of an optimal combination between cultivar, fertilization with macronutrients and micronutrients, stimulation with growth regulators, their rates, doses and treatment periods in specific agro-ecological conditions (Rapparini et al., 1984).

There are registered a certain number of biologically active substances which have positive influence on grain yield and grain quality of the durum wheat (Lalev et al., 2000; Kolev et al., 2005).

Growth regulators properly selected and used an appropriate level of mineral fertilization, increase grain yield and grain quality in cases where traditional methods and tools are little effective or nearly exhausted their options. In literature, there is evidence that common and durum wheat respond differently to treatment with the same preparations (Pomati, 1987; Pestryakov et al., 1991). According to some authors

[1]Trakia University, Faculty of Agriculture, 6000, Stara Zagora, Bulgaria (delchevgd@dir.bg)

(Rapparini et al., 1987) in their reaction to some retardants durum wheat is nearer to barley than to common wheat.

The purpose of this investigation was to investigate the influence of some stimulators on grain yield of durum wheat, its structural elements and grain quality.

Material and methods

The research was conducted during 2010 - 2012 on pellic vertisol soil type.

The research was conducted during 2010 - 2012 on pellic vertisol soil type. It was carried out a two factor experiment as a block method in 4 repetitions, on a 20 m^2 harvesting area, after sunflower predecessor. Factor A – cultivars, include 2 Bulgarian durum wheat cultivars: Deyana and Zvezdica (*Triticum durum var. valenciae*). Factor B – stimulators, include 9 variants: untreated check and 5 growth stimulators – H-40 in doses of 300 and 500 ml ha^{-1}, XH-100 in doses of 1 and 1.2 l ha^{-1}, TH-140 in doses of 2.5 and 2.8 l ha^{-1}, X-80 in dose of 800 ml ha^{-1} and T – 100 in dose of 2.5 l ha^{-1}.

All stimulators were treated during the tillering stage of durum wheat with working solution 200 l ha^{-1}. Early in spring was done a feeding with 120 kg N ha^{-1}, in the form of ammonium nitrate (NH_4NO_3). All other agronomic practices were carried out according to accepted technology for growing of durum wheat.

It was investigated influence that investigated stimulators have on the grain yield of durum wheat and also on the structural elements of the yield - spike length, spikelets per spike, grain per spike and the grain weight per spike in main tiller and in second tiller. It was studied the changes occurring in the physical properties of the grain - 1000 grains weight, test weight, virteousness - and biochemical properties of the grain - protein content, wet and dry gluten contents. Mathematical data processing is done by the method of analysis of variance.

Results and discussion

Data about the effects on grain yield of growth stimulators which were included in the investigation (Table 1) show that more of the stimulators have mathematically proven increase in grain yield. The highest increase of yields, average for the investigation period, was obtained under the influence of stimulators XH-100 and TH-140 at both durum wheat cultivars. Increase is to 10.3 % at cultivar Deyana and to 9.6 % to cultivar Zvezdica. It is mean 440 - 450 kg more grain per hectare. During 2011 and 2012 stimulators X-80 and T-100 significantly increased grain yield at cultivars Deyana and Zvezdica, but during 2010 they did not have mathematically proven increase of grain yield. These two stimulators are strongly influenced by weather conditions during the growing period. The increase of dose of the stimulator H-40 from 300 ml ha^{-1} to 500 ml ha^{-1} has depressing effect on the both durum wheat cultivars.

To explain changes in grain yield were investigated some of the structural elements that determine it. The results of structural analysis show, that the increase in grain yield is due to the greatest extent of the increase in the grain number per spike and the grain weight per spike in the spikes of main and second tiller (Tables 2 and 3). The greatest increase in the grain number per spike and the grain weight per spike compared to

Table 1. Grain yield and structural elements of the yield (mean 2010-2012)

Variants		*Grain yield*		*Differences compared to check, (kg ha^{-1})*	*Significant*
Cultivars	*Stimulators*	*kg/ha*	*%*		
Deyana	-	4288	100	0	-
	H 40 – 300 ml/ha	4453	103.8	+16.5	-
	H 40 – 500 ml/ha	4405	102.7	+11.7	-
	XH 100 – 1 l/ha	4699	109.6	+41.1	+++
	XH 100 – 1.2 l/ha	4644	108.3	+35.6	++
	TH 140 – 2.5 l/ha	4577	106.7	+28.9	++
	TH 140 – 2.8 l/ha	4624	107.8	+33.6	++
	X 80 – 800 ml/ha	4476	104.4	+18.8	-
	T 100 – 2.5 l/ha	4640	108.2	+35.2	++
Zvezdica	-	4356	100	0	-
	H 40 – 300 ml/ha	4553	104.5	+19.7	-
	H 40 – 500 ml/ha	4498	103.3	+14.2	-
	XH 100 – 1 l/ha	4594	105.5	+23.8	+
	XH 100 – 1.2 l/ha	4739	108.8	+38.3	+++
	TH 140 – 2.5 l/ha	4573	105.0	+21.7	+
	TH 140 – 2.8 l/ha	4662	107.0	+30.6	++
	X 80 – 800 ml/ha	4571	104.9	+21.5	+
	T 100 – 2.5 l/ha	4445	102.0	+8.9	-

untreated control is obtained by stimulators XH-100 and TH-140. The increases of the structural elements are mathematically proven at the both cultivars – Deyana and Zvezdica. The effect of investigated stimulators on the indexes spike length and spikelets number per spike is significantly less. The investigated preparations influence not proven on these structural elements of yield. It must be taken into account that the spike length and spikelets number per spike have little influence on the grain yield. The spike can be very long, but lax, with fewer spikelets per spike spindle. More important for the durum wheat are all of spikes to have many grains, well ripened, without sterile spikelets at the base and at the top of the spikes.

Durum wheat is the main raw material for the production of high quality pasta. To meet this requirement, it must be grown in suitable agro technology, providing a high-quality grain. From this perspective the stimulating of growth with stimulators is important for improving the quality of the durum wheat grain.

Treatments with the investigated stimulators have positive effect on the of 1000 grain weight (Table 4). The 1000 grain weight is the biggest and mathematically proven by treatment with stimulators TH-140 and XH-100. Stimulators H-40, X-80 and T-100 do not influenced on this index. The values of this index are over international standards at all variants.

Test weight characterizes the density of the grain and is one of the important technological parameters. Usually with increasing nitrogen rate specific weight decreases. This is associated with the preparation of a more lax tissue cell at a high nitrogen fertilizer, especially under dry conditions. Use of stimulators not adversely

Table 2. Structural elements of the main tiller (mean 2010-2012)

Variants		*Spike length (cm)*	*Spikelets number per spike*	*Grains number per spike*	*Grain weight per spike (g)*
Cultivars	*Stimulators*				
Deyana	-	6.8	21.8	36.0	1.94
	H 40 – 300 ml/ha	7.4	22.2	44.8	2.36
	H 40 – 500 ml/ha	7.3	22.4	40.4	2.08
	XH 100 – 1 l/ha	7.5	22.4	47.4	2.38
	XH 100 – 1.2 l/ha	7.6	23.0	48.4	2.44
	TH 140 – 2.5 l/ha	7.7	23.0	49.0	2.50
	TH 140 – 2.8 l/ha	7.9	23.1	50.4	2.62
	X 80 – 800 ml/ha	7.2	21.8	40.6	2.04
	T 100 – 2.5 l/ha	7.4	22.4	44.4	2.36
Zvezdica	-	7.7	22.0	38.2	2.10
	H 40 – 300 ml/ha	7.8	22.8	40.0	2.22
	H 40 – 500 ml/ha	7.8	23.8	38.8	2.18
	XH 100 – 1 l/ha	7.6	23.2	41.6	2.24
	XH 100 – 1.2 l/ha	7.9	23.8	43.0	2.40
	TH 140 – 2.5 l/ha	7.7	24.0	42.0	2.26
	TH 140 – 2.8 l/ha	7.7	22.2	40.8	2.28
	X 80 – 800 ml/ha	7.7	22.6	40.8	2.22
	T 100 – 2.5 l/ha	7.8	22.4	40.2	2.18
LSD 5%		1.0	1.1	4.4	0.33
LSD 1%		1.9	2.0	6.0	0.43
LSD 0.1%		3.0	3.2	7.6	0.58

affects the test weight of the grain. It retains its high levels characteristic of durum wheat - all variants except weeded control have test weight over 78 kg.

The use growth stimulators H-40, XH-100, TH-140, X-80 and T-100 leads to proven increases virteousness of durum wheat grain compared weeded check, although this was some variation during years.

The keeping the physics properties of the grain (1000 grain weight, test weight and virteousness) high and stable guaranteed good mill qualities and high semolina output.

Other indexes included in the investigation characterized the biochemical properties of the grain from the different variants as raw material for the pasta production. The protein quantity and the wet and dry gluten quantities are one of the most important indexes, leading to pasta with a good culinary quality.

The protein quantity is definitely by cultivar, but it varies depending on weather conditions and the agro technology. Data shows that it increases proved under the influence of investigated growth stimulators. Protein quantity is the highest by treatment with stimulators XH-100 and TH-140 during tillering stage of durum wheat.

Wet and dry gluten quantities are an important element of the quality characteristics of the grain. The obtained data show that the growth stimulators increase the value of wet and dry gluten compared untreated control. Wet and dry gluten quantities are the highest by use of stimulators XH-100 and TH-140. All variants are over the standard requirements about the wet gluten quantity - more than 28 %. The ratio between wet

Table 3. Structural elements of the second tiller (mean 2010-2012)

Variants		*Spike length (cm)*	*Spikelets number per spike*	*Grains number per spike*	*Grain weight per spike (g)*
Cultivars	*Stimulators*				
Deyana	-	5.2	16.8	22.4	0.94
	H 40 – 300 ml/ha	5.7	18.4	23.4	1.03
	H 40 – 500 ml/ha	5.7	18.8	27.8	1.14
	XH 100 – 1 l/ha	5.9	18.6	27.8	1.26
	XH 100 – 1.2 l/ha	6.0	20.4	29.6	1.26
	TH 140 – 2.5 l/ha	5.9	20.0	28.0	1.22
	TH 140 – 2.8 l/ha	6.0	20.2	29.6	1.30
	X 80 – 800 ml/ha	5.8	19.6	29.4	1.18
	T 100 – 2.5 l/ha	5.7	18.0	27.8	1.02
Zvezdica	-	5.9	18.4	23.2	1.02
	H 40 – 300 ml/ha	6.1	18.8	26.7	1.24
	H 40 – 500 ml/ha	6.1	18.2	26.0	1.20
	XH 100 – 1 l/ha	6.2	20.0	27.2	1.28
	XH 100 – 1.2 l/ha	6.6	20.6	29.6	1.38
	TH 140 – 2.5 l/ha	6.3	20.6	27.2	1.28
	TH 140 – 2.8 l/ha	6.5	20.6	29.4	1.36
	X 80 – 800 ml/ha	6.2	20.6	28.6	1.24
	T 100 – 2.5 l/ha	6.1	20.3	27.4	1.12
LSD 5%		0.6	1.4	3.5	0.20
LSD 1%		1.4	2.3	5.0	0.31
LSD 0.1%		2.6	3.5	6.7	0.44

and dry gluten (2.5 - 3 to 1) remains unchanged and favorable for producing high quality pasta. The differences in the biochemical properties of the grain are due to the changes in the speed and nature of the physiological and biochemical processes in plants occurring under the influence of different stimulators. Their use has a direct stimulating effect on durum wheat.

Conclusion

The highest grain yield at durum wheat cultivars Deyana and Zvezdica is obtained by influence of growth stimulators XH-100 and TH-140.

Increase the dose of stimulator H-40 depresses durum wheat.

The lowest yields are obtained by use of stimulators X-80 and T-100 at the both durum wheat cultivars.

The grain yield increase by investigated stimulators is due to the increase in the grain number per spike and the grain weight spike in main tiller and second tiller.

The 1000 grain weight, test weight, virteousness, protein quantity, wet and dry gluten quantities are increased by influence of the investigated growth regulators.

Physical and biochemical properties oh the grain are the highest by treatment with stimulators XH-100 and TH-140.

Table 4. Physical and biochemical properties of the grain (mean 2010-2012)

Variants		1000 grain weight (g)	Test weight (kg)	Vitreousness (%)	Protein (%)	Gluten (%)	
Cultivars	Stimulators					Wet	Dry
Deyana	-	49.0	77.2	81.2	17.87	29.8	10.9
	H 40 – 300 ml/ha	49.6	78.3	86.4	18.38	31.0	11.6
	H 40 – 500 ml/ha	50.6	78.4	87.4	18.40	31.0	11.7
	XH 100 – 1 l/ha	52.2	78.3	87.8	18.55	32.2	12.0
	XH 100 – 1.2 l/ha	52.4	78.7	87.8	18.66	32.4	12.1
	TH 140 – 2.5 l/ha	52.8	78.4	88.2	18.65	32.5	12.1
	TH 140 – 2.8 l/ha	52.8	78.3	86.4	18.74	32.4	12.2
	X 80 – 800 ml/ha	50.8	79.2	87.0	18.40	31.5	11.7
	T 100 – 2.5 l/ha	49.6	78.3	86.2	18.40	31.4	11.9
Zvezdica	-	51.0	78.0	81.4	17.63	28.8	10.7
	H 40 – 300 ml/ha	52.8	78.7	89.6	18.40	31.0	11.7
	H 40 – 500 ml/ha	52.2	78.9	86.8	18.45	31.4	11.9
	XH 100 – 1 l/ha	54.0	78.6	87.8	18.59	32.3	12.0
	XH 100 – 1.2 l/ha	55.2	78.5	87.8	18.60	32.4	12.0
	TH 140 – 2.5 l/ha	55.2	78.4	87.2	18.68	32.6	12.3
	TH 140 – 2.8 l/ha	55.4	79.1	87.2	18.75	32.4	12.2
	X 80 – 800 ml/ha	52.0	79.0	86.4	18.41	31.5	11.7
	T 100 – 2.5 l/ha	51.8	78.3	87.4	18.42	31.3	11.6
LSD 5%		2.8	2.3	2.0	0.40	1.5	0.6
LSD 1%		4.4	3.5	4.1	0.55	2.6	1.5
LSD 0.1%		6.2	4.7	5.8	0.80	4.7	2.6

The use of these two plant growth regulators is suggested as an element of the technology for growing of durum wheat.

References

Kolev, T., N. Tahsin, S. Yanev, 2005 Effect of growth stimulator Imunotsitofit on the productivity of durum wheat. Scientific papers of AU-Plovdiv, vol. L, vol. 4, 85-88.

Lalev, Ts., Gr. Delchev, G. Panayotova, D. Nikolov, I. Saldzhiev, Sh. Yanev, M. Deneva. 2000 Successes of research in area of technology for growing durum wheat. Plant Science, 9 (37) 682-687.

Pestryakov A, Pankin A and Remezov V, 1991. The effectiveness of some retardants on growth winter wheat. Agrochemisty, № 3, 22-24.

Pomati, S., 1987 - Il programma grano Basf. Informatore Agrario, 43 (24), 51-55.

Radišič, M., D. Stajkovič, K. Kolev. 1997. Influence of natural growth regulator Agrostemine on the wheat seed germination. Casopis za procesnu tehniku i energetiku u poljoprivredi, 1 (1-2) 34-35.

Rapparini, G., Benussi, D., Bassi, F. 1987 - Verifica dell'utilita d'impiego di fitoregulatori di crescida sui cereali vernini. Informatore Agrario, 43 (5), 29-35.

Rapparini, G., G. Giordani, G. Logi, G. Contanelli, 1984. Resultati delli prime esperience con i nuovi regulatori di crescita. Informatore Agrario, 40 (12) 79-85.